East Engin.
Library
SEP 9 1925

Volume II August, 1925 *Number 8*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Worsted and Woolen Machinery

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

TEXACO LUBRICANTS

For Worsted and Woolen Machinery

SCOURING MACHINERY

Wool Washers and Dryers

Bearings (*oil lubricated*)	TEXACO TEXOL OIL C OR D, OR TEXACO ALEPH OIL
(*Grease lubricated*)	TEXACO GREASE NO. 3
Cams	TEXACO TEXOL OIL C OR D, OR TEXACO GREASE NO. 1 OR NO. 3
Gears and Chains	TEXACO TEXOL OILS
(*according to installation*)	TEXACO GREASE NO. 1 OR NO. 3, OR TEXACO THUBAN COMPOUNDS

CARDING MACHINERY

(Worsted and Woolen)

Comb Boxes	TEXACO STAR GREASE A
Plain Bearings	TEXACO TEXOL OIL C OR D, OR TEXACO ALEPH OIL
Ball or roller bearings (*in oil-tight housings*)	TEXACO SPICA OIL
(*where leakage may occur*)	TEXACO STAR GREASES
Gears and Chains	TEXACO TEXOL OILS
(*according to installation*)	TEXACO GREASE NO. 1 OR NO. 3, OR TEXACO THUBAN COMPOUNDS

CLEANSING EQUIPMENT

Dusters, Willows, Pickers, Garnetts, etc.

Plain bearings (*oil lubricated*)	TEXACO TEXOL OIL C OR D, OR TEXACO ALEPH OIL
(*Grease lubricated*)	TEXACO GREASE NO. 3
Ball or roller bearings (*in oil-tight housings*)	TEXACO SPICA OIL
(*where leakage may occur*)	TEXACO STAR GREASES
Gears, Chains, etc.	TEXACO TEXOL OILS
(*According to installation*)	TEXACO GREASE NO. 1 OR NO. 3, OR TEXACO THUBAN COMPOUNDS

GILLS AND BACKWASHERS

(Worsted)

Roll and other bearings	TEXACO TEXOL OIL C OR D, OR TEXACO ALEPH OIL.
Fallers, Screws, Slides, etc.	TEXACO GREASE NO. 1.
Gears, etc.	TEXACO TEXOL OILS
(*according to installation*)	TEXACO GREASE NO. 1 OR NO. 3, OR TEXACO THUBAN COMPOUNDS.
Backwasher Drums	TEXACO HYTEX GREASES TEXACO MARFAK COMPOUND

(Continued on Inside Back Cover)

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

Copyright 1925, by The Texas Company

Vol. XI August, 1925 No. 8

Change of Address: In reporting change of address kindly give both old and new addresses.

"While the contents of LUBRICATION are copyrighted, other publications will be granted permission to reprint on request, provided article is quoted exactly and credit given to THE TEXAS COMPANY."

Lubrication of Worsted and Woolen Machinery

WOOL—the product of an industry—sheepraising—which was held in high esteem even in Biblical times, has for centuries been classed as one of the major essentials in the life of civilized man. His appraisal of its worth has been indicated by bloodshed, by treaties, by commerce, by the development of mechanical devices even in the middle ages.

Little wonder then that the woolen industry today is second but to cotton in the field of textiles. The annual output of the world is upward of three billion pounds; the total power required in the United States alone is above 487,000* horse power; to serve the machinery involved the average oil consumption (annually) is in the neighborhood of 4.0 gallons per horsepower. Furthermore the probable cost of the approximately 2,000,000 gallons of oil involved, would range in the neighborhood of $1,000,000 per year. And this is for lubricating oils alone, not to mention the hundreds of thousands of pounds of grease and gallons of stock or conditioning oils required in the manufacture of woolens and worsteds. Truly it is an industry that warrants consideration of its lubricating problems—that is entitled to the cooperation of the petroleum specialist.

The industry as a whole is divided into two distinct classifications, dependent upon the nature of the wool which is to be worked. Broadly speaking these comprise the manufacture of (1) worsted, and (2) woolen goods. The length of the wool fibres is the determining factor. In other words, the worsted industry works with a long fibred product such as for example, combing wool. Usually two inches in length is the dividing line, all wools which range below this length are, in general, apportioned to the woolen mill, being frequently known as clothing wools. Inasmuch as these shorter fibres do not permit of satisfactory combing, this process is not involved in the usual handling or the manufacture of woolens.

Scouring

This is the first essential treatment to which raw wool is subjected after clipping and sorting. As its name implies, this process constitutes a washing and rinsing treatment for the purpose of removing the natural grease or yolk, any dirt that may be present, and also dried perspiration. The scouring out of grease involves the use of alkaline solutions. Dirt and perspiration, however, can be usually removed by soap solutions.

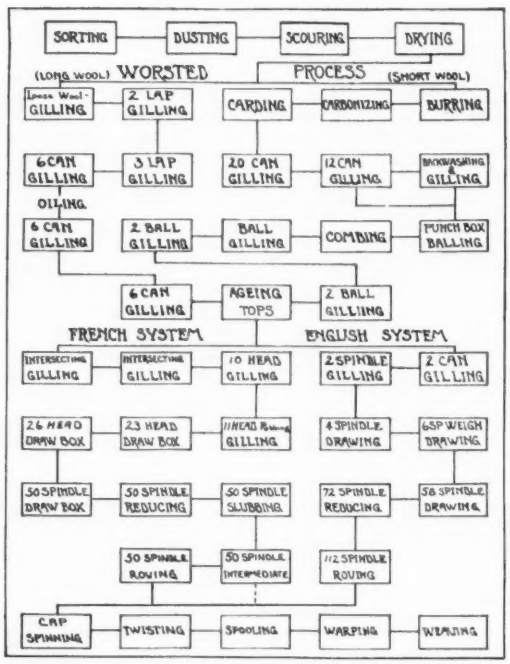
Scouring is a general process applicable to wool, be it of the long or short staple variety, and regardless of whether it is to be used in the manufacture of worsteds or woolens. The only essential difference is that short wool as used for clothing woolens is given more intensive treatment, for the presence of oily

*Acknowledgment is made to The International Acceptance Bank, Inc., and to Textile World for information and data furnished in connection with this article.

matter and moisture is not as essential as in the case of wools which are to be combed.

Scouring Machinery Lubrication

The machinery used in the scouring of wool includes a washing device frequently very much like a laundry washer, one or more rinsing vats and water baths, and the necessary dryers of the apron or rotary type, etc.,



Courtesy of The Massachusetts Institute of Technology.

Fig. 1.—A worsted process chart showing the number and sequence of operations involved.

to which the wool is passed after rinsing. The essential moving elements involve shaft and journal bearings, gears and driving chains. Frequently, however, these latter will be superseded by belting, connections being made from overhead line shafting.

Lubrication of scouring machinery is a relatively simple matter. The wool in its raw state is not as yet subject to damage from splashed or dripped lubricants, therefore the care that must be observed later on in their application is not as necessary. This should not be implied as meaning that sloppy usage may be tolerated. The progressive Mill Manager desires oil and grease economy quite as much in his scouring room as elsewhere in the mill.

For plain bearings of wool washers, dryers and other mechanisms involved in scouring, either oil or grease can be used according to the means available for applying the lubricants. For oil cups, ring oilers and other similar devices a straight mineral machine oil of from 300 to 400 seconds Saybolt viscosity at 100° Fahr. will be satisfactory. Where grease, in turn, is applicable a medium grade of compression cup grease will serve the purpose. This latter will also be applicable to such cam mechanisms as may be involved, as well as to exposed gears and driving chains.

The latter are frequently subject to a wide range of lubricants according to their type, method of installation, speed and size. Preferably, they should be enclosed in oil tight housings, when it will be possible to lubricate them more satisfactorily with a heavy oil or gear compound. On larger gears a product having a viscosity akin to cylinder stock (i. e., from 100 to 150 seconds Saybolt at 210° Fahr.) will give adequate lubrication and protection to the teeth.

THE MANUFACTURE OF WORSTED

Carding

Following the process of scouring, wool which is designed for the manufacture of worsted is subjected to carding or the opening out of the fibres to render them parallel as far as possible. The essential process of carding involves passing the wool between feed rollers and cylinders surfaced with numerous small wire ends. These wires are held in place by leather or fillet backings in which they are set. There are a number of such cylinders varying in direction of rotation, speed and diameter. As a result, after the wool has been once fed in by the first or "licker-in" roller, it is subjected to a continued rending or pulling action always in the same direction, which serves to disintegrate and lay the fibres parallel as far as possible.

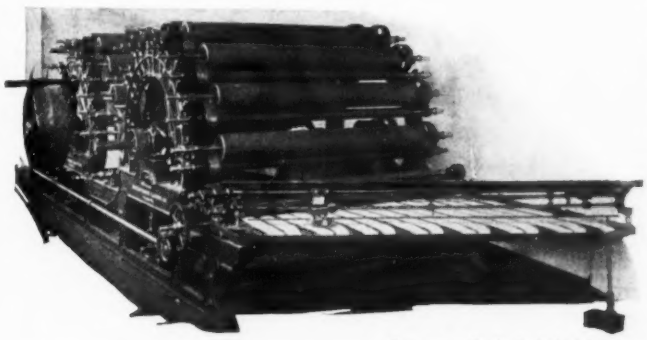
As the wool passes over the last roller, or doffing cylinder, it is removed by a doffing comb which vibrates across the surface of this roller. The wool at this stage resembles a fibrous sheet. It is then condensed into the form of a continuous rope or "sliver" by being led through a funnel-shaped orifice, to be ultimately wound into bails ready for gilling and backwashing.

Lubrication

The carding machine presents the first lubricating problem in the mill, by reason of the construction and motion of its comb box. As has been stated, the action of the doffer comb is vibratory, this reciprocating motion being brought about by a suitable cam or eccentric mechanism. These eccentric mechanisms run in a bath of lubricant. Due to the fact that the comb is usually set with but a few thousands of an inch clearance between itself and the doffer cylinder, it is ab-

solutely essential that the comb box be kept at an even temperature to insure maintenance of this distance and even running of the sliver.

The successful lubrication of this box has always been a potential prob'em. Perhaps this has been chiefly due to the fact that textile engineers have been more or less in the dark as to the proper lubricant to use. Many have regarded grease or a fairly viscous oil as the proper lubricant. On the other hand, greases are relatively inert. In addition, both greases and high viscosity oils will render it difficult to secure the low frictional temperatures which are so necessary.



Courtesy of S. K. F. Industries, Inc.

Fig. 2.—General view of a Smith and Furbush wool and worsted card equipped with ball bearings on the main cylinders, etc.

The probable reason for this inherent preference of heavier or more viscous lubricants has been the necessity for preventing splashing or throwing from the comb box where it is subjected to the continued churning action of the cam or eccentric mechanism.

Experiments with such equipment, however, have developed that the use of a lower viscosity lubricant will promote lower frictional temperatures and insure the maintenance of a more uniform clearance between the comb and doffer cylinder. Such a lubricant should be of the nature of a light liquid grease. The soap content will give the requisite viscosity to prevent splashing or throwing, in addition the actual lubricant in the form of a relatively light mineral oil will result in the minimum of frictional temperature.

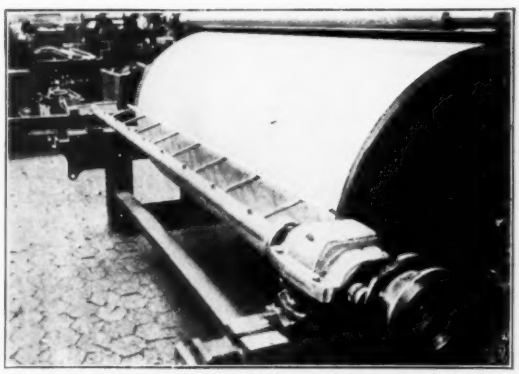
Throwing and splashing of lubricants from the comb box is important in carding, due to the fact that the leather backing of the card clothing is susceptible to deterioration when spotted with mineral oil.

Roll bearings of a carding machine when they are of the plain bearing type can be effectively lubricated by a straight mineral oil of from 300 to 400 seconds Saybolt viscosity at 100° Fahr. The utmost care must be taken, however, to prevent oil leakage from these bearings to the card clothing on the main cylinder. The detriments have already been mentioned.

For this reason, ball bearings have been experimented with and successfully applied to such card roll bearings. It is claimed that when installed in oil-tight housings, they effectively prevent leakage of lubricants to the card clothing. Furthermore, they materially reduce the starting torque, making it practicable to start a woolen card with a minimum of power, and practically no difficulty after shut-downs.

When ball bearings are set in oil-tight housings a straight mineral lubricant of approximately 100 seconds Saybolt at 100° Fahr. will give effectual service. In event of leakage being possible, however, it will be advisable to resort to a fairly heavy grade of liquid grease.

Gears and chains in turn will function effectively if a straight-mineral lubricant of from 100 to 150 seconds Saybolt at 210° Fahr. is used. On the other hand, it is perfectly practicable to use a medium bodied cup grease or machine oil, if desired, although more care will generally be necessary to guard against splashed or dripped lubricants, and possible damage to the card clothing. Whenever possible, it is of course best to enclose such equipment in oil-tight guards or casings. In this way bath lubrication will be made possible with the result that wear will be minimized and economy probably increased.



Courtesy of Proctor & Schwartz, Inc.

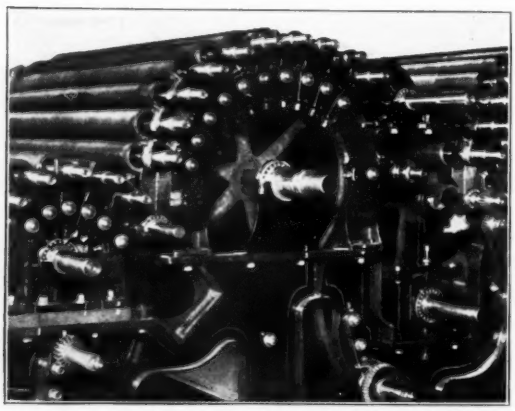
Fig. 3.—Doffer comb on a Smith and Furbush card. The comb box can be noted in the foreground.

Gilling and Backwashing

Leaving the carding machine the balled slivers of wool are ready for drawing and combing. This first process which is begun in the backwasher involves the passage of a

number of slivers through suitable washing baths to remove any remaining foreign matter. The product is then drawn through a hot air drying device and automatically combined into one.

A number of such resultant slivers are then subjected to drawing or reduction by passage



Courtesy of S. K. F. Industries, Inc.

Fig. 4.—Side view of a garnett or waste restoring machine showing the extent to which self aligning ball bearings can be used on cylinders and rolls.

simultaneously through a series of gill boxes. These latter involve essentially a number of relatively slow speed rollers which serve to first flatten the slivers and then draw them down in diameter and subject the fibres to further straightening; ultimately the product passes through a condenser funnel to be once again brought to the form of a sliver. The number of gilling treatments that may be necessary will depend upon the nature of the stock.

Stock Conditioning or Fibre Lubrication

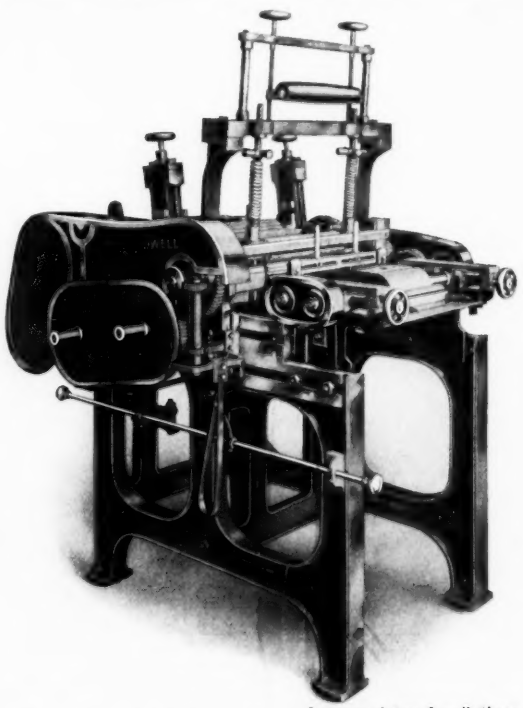
In the process of gilling, wool is usually subjected to lubrication or "conditioning;" in other words it is treated with a certain amount of oil in order to soften the fibres and facilitate subsequent combing. The product which is generally used for this purpose can be either an emulsifiable oil or a straight mineral lubricant. Oxidation is an important feature in such products, which are frequently termed "wool oils," due to the relationship borne to gumming. Mineral oils in general will have the least tendency to oxidize, gum or promote spontaneous combustion when the wool is to be stored for any length of time. On the other hand they may be somewhat more difficult to wash out from the product.

Another important point is the matter of free fatty acids. These, of course, will tend to exert a corrosive action on certain parts of the machinery as for example, the combing pins. For this reason the choice of wool oils is a decidedly important matter, for any emulsifiable product containing fatty oils will tend to react to free fatty acids later on. Mineral oils, of course, show this tendency to the least degree. Where they are applicable, they should be used sparingly, and careful studies made to determine the requisite amounts. In general an oil of medium viscosity will be best. If too light it might not coat the fibres to the requisite degree, whereas if too heavy, penetration of the wool might be interfered with and an appreciable drag imposed upon the comber and other machinery.

Lubrication of Gill Boxes and Backwashers

Apart from the matter of stock conditioning or fibre lubrication as mentioned above, the use of oils on gill boxes and backwashers involves but one possible difficulty, i. e., in regard to the drums or cans on certain types of the latter machines.

In other words, lubrication is a matter of judicious application of oils, greases or gear



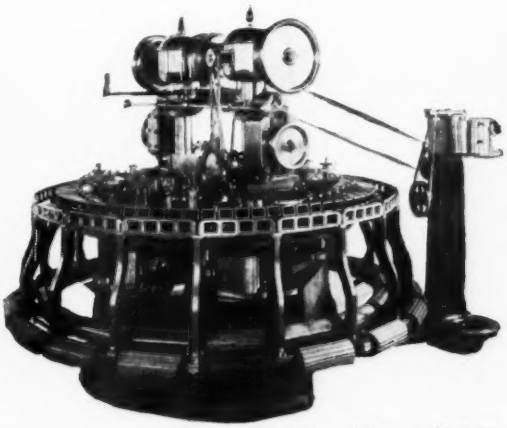
Courtesy of Saco-Lowell Shops.

Fig. 5.—A worsted single can gill box showing constructional details. Bearings and gears are the essential wearing parts involved.

lubricants to the several bearings, driving chains and gears which are involved. The essential products are specified in the chart which accompanies this article.

Backwasher drums or cans involve friction between the drums and their concentric wear-

ing surfaces. Temperature conditions are usually relatively high and it is frequently difficult to maintain the requisite film of lubricant within the clearance spaces. For this purpose a relatively inert lubricant, or grease of high melting point will be suitable, although



Courtesy of James Smith & Son.

Fig. 6.—A wool combing machine showing details of construction.

it will be practicable in some cases to use a steam cylinder oil. Where such drums are eliminated, of course, the matter of lubrication is essentially simplified.

Combing

The slivers are ready for combing after sufficient drawing, etc., in the gill boxes. This process, as its name implies, constitutes the removal of shorter fibres which are not capable of suitable spinning, and the final straightening or paralleling of the remaining long fibres as far as possible. The resultant product as it passes from the comber is known as a "top." Frequently it is passed through a finisher gill before winding into a suitable ball for spinning.

The short or waste fibres which are removed are known as "nibs" or "noils." They are not actually wasted, however, being suited to either woolen or knitting mill operations. These "noils," etc., will contain the majority of the oil which has been added to the wool in gilling to facilitate combing. In consequence the resultant "tops" can be aged or stored with usually perfect safety, especially where mineral oils have been used for conditioning purposes. If emulsifiable compounds containing animal fats have been employed, there will be a possibility of rancidity, gumming, oxidation and spontaneous combustion occurring. As a result they must be used as sparingly and evenly as possible. This also applies to mineral oils, but from another angle. These latter products if used to excess will tend to cause staining and discoloration of the wool during storage, and may result in a certain amount of gumming as well.

Combing Machine Lubrication

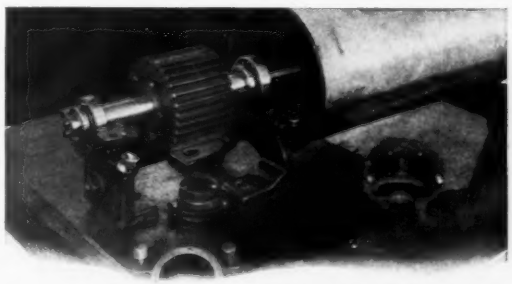
The comber, due to the proximity of its numerous intricate roll bearings, cams, etc., to the wool "tops," requires careful attention from a lubrication point of view. In selecting lubricants for such machines, the matter of body or viscosity will frequently be contingent upon the operating temperatures, for steam heat by means of an adjacent steam box is regarded as being of considerable advantage in bringing about efficient combing. As a result, especially on revolving table rollers and drawing off rollers, will it be necessary to use a lubricant of sufficient body to adequately resist the thinning out effects of the heat involved. A straight mineral oil of from 500 to 750 seconds Saybolt at 100 deg. Fahr. will usually serve the purpose satisfactorily. On the other hand, where grease lubrication is preferred, a medium bodied liquid grease should meet the requirements.

Cam motions of a combing machine should be lubricated with a medium bodied cup grease which will have sufficient body to resist the pounding of the cam finger, and any tendency to drip or throw off.

Daubing brushes in turn will usually require a spindle oil of approximately 100 seconds Saybolt viscosity at 100 deg. Fahr.

Drawing and Spinning

The essential purposes of all previous processes have been to prepare, parallel and straighten the fibres for spinning. Dependent on the nature of the stock, the subsequent drawing processes will involve a number of steps. By a series of such drawing operations, several

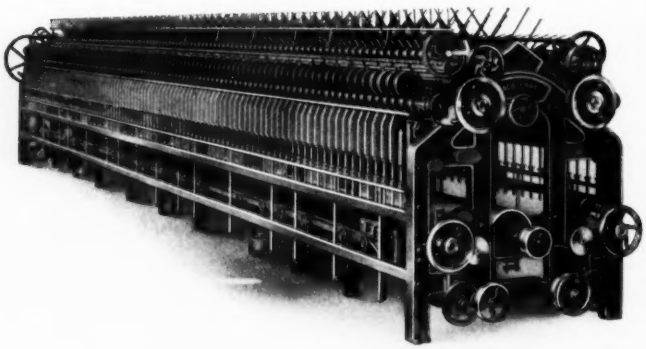


Courtesy of S. K. F. Industries, Inc.

Fig. 7.—Details of the cylinder drum of a spinning frame showing self-aligning ball bearing mounting.

slivers are condensed down to one, each successive operation reducing the product in fineness. The final drawing is carried out on a roving machine which gives the requisite amount of preliminary twist for ultimate spinning. Such twisting is necessary where

spinning is carried out on a ring, cap or flyer type spindle frame, according to the English or Bradford system. This is most generally used in the manufacture of worsteds. The French system, which usually employs the mule frame, requires no preliminary twist in the slivers.



Courtesy of Saco-Lowell Shops.

Fig. 8.—A worsted cap spinning frame as viewed from the builder end.

Spinning

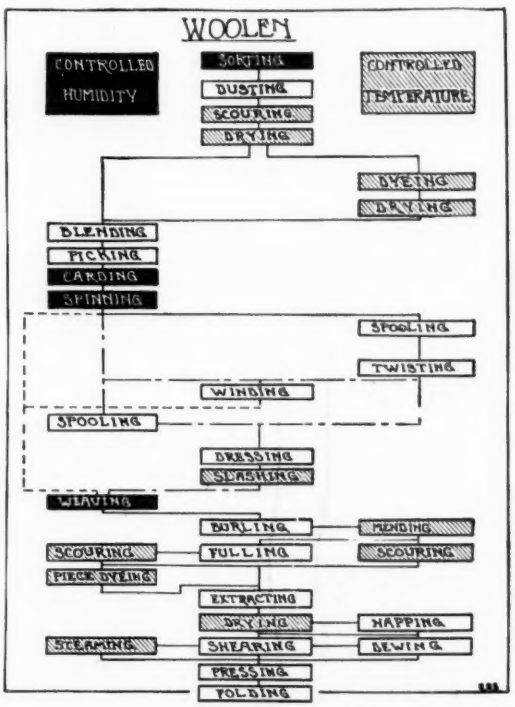
This process differs but little from the roving or final drawing which is given to the yarn. Essentially the purpose is to impart to the yarn the necessary twist and strength for weaving. It is brought about in a similar manner by unwinding the yarn from a series of spools, passing it through variable speed rollers and winding it onto vertical spindles below.

Three types of continuous spinning frames can be used for worsteds, according to the yarn involved, as already mentioned. In general they will have much the same appearance, the essential difference being in the manner in which the spindles are rotated, and the control of the yarn as it is wound onto the bobbins. Cap spinning is probably the most generally used for worsteds. It is advantageous in that vibration is low due to the motion of the bobbins in fixed caps, therefore spindles may be rotated at higher speeds. This of course involves more attention to selection and application of spindle oils.

Lubrication

The essential problems in the lubrication of drawing, roving and spinning frames, as well as of twisters (which serve to combine spun yarns for weaving) involve the spindles and variable speed rolls. Speeds are high, continuous operation is mandatory, clearances are low, and a minimum of friction is necessary to effective production. Furthermore, the yarn must be protected against oil spots as much as possible. As a result all such machines require the most careful attention, and only mill mechanics conversant with the operating parts and the capabilities of the lubricants employed should take care of lubrication.

For example, take the front rolls of drawing frames, through which slivers pass in the drawing and straightening process. The important item here is to lubricate with the maximum amount of protection to the leather coverings of the rolls. In other words, the lubricant must not creep from the bearings, otherwise the rolls might be ruined and the yarn stained. The lubricant must therefore be relatively viscous in order to insure its retention in the bearings; at the same time, however, the presence of a small amount of soap will facilitate removal of oil spots in scouring and bleaching. For this reason a liquid grease is preferred by many operators. This same lubricant is applicable to gearing and cam mechanisms, etc., although a somewhat heavier product such as a light cup grease would perhaps give greater economy.

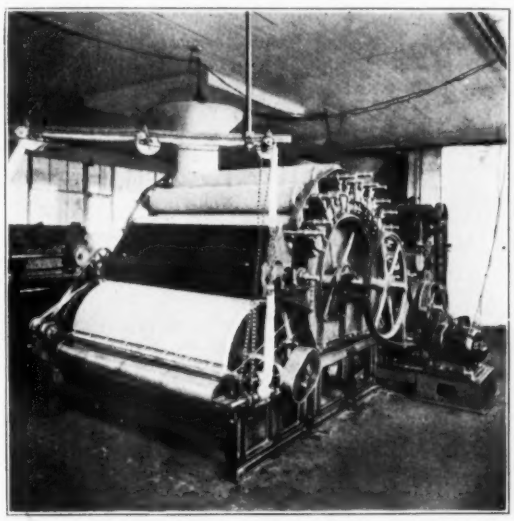


Courtesy of C. J. Tagliabue Mfg. Co.

Fig. 9.—Flow chart of the woolen industry showing the various processes which may require automatic control.

While roll bearings, gears, etc., are important features in regard to lubrication, the

spindles are usually regarded as involving the outstanding problem due to the high speeds involved. As a result the matter of viscosity is a most important item, for power and frictional losses must be reduced in every way possible, otherwise a considerable "drag" or excess of tension may be imposed on the yarn. It is generally agreed that within certain limits the viscosity of a spindle oil should vary inversely with the speed involved. The lower limit is usually accepted as being in the neighborhood of 60 to 65 seconds Saybolt at 100 deg. Fahr. The upper ranging from 100 to 150 seconds.



Courtesy of Proctor & Schwartz, Inc.

Fig. 10.—A woolen breaker card showing delivery of sliver or roving to the finisher card. Note method of drive.

From the viewpoint of viscosity the suitability of a spindle oil can generally be noted by the temperature difference which exists between the spindles and the surrounding atmosphere. Under ideal conditions there should be no such difference. It is impossible, however, to eliminate friction absolutely, therefore spindles will operate somewhat above room temperatures A difference of approximately 15 deg. Fahr. may be regarded as a fair average.

Of course the higher the viscosity of the oil the greater will the internal friction probably be, with the result that more power will be required to drive the spindles. For this reason, every care should be taken to observe the above temperatures and reduce the viscosity of the oil as far as possible. On the other hand, this should not be carried to an extreme, otherwise there would be danger of metal-to-metal contact occurring. In consequence metallic friction would probably build up and excessive wear might occur. This would also be indicated by abnormal spindle temperatures (usually, however, much higher), excessive power consumption and perhaps ultimate seizing of the spindles. Long before this extreme, however, frequent breakage of the yarn would probably indicate that something was radically wrong.

In addition to this matter of viscosity the question of compounding is also of importance. It is essential, of course, to prevent spindle oil from coming in contact with the yarn as far as possible. Frequently, however, constructional details, carelessness or other adverse operating conditions will render this ideal difficult to attain at all times. As a result it will be advisable in such cases to use a spindle oil which contains a few per cent. of animal oil in order to facilitate subsequent removal of oil spots or discoloration. It is needless to say, of course, that the mineral constituent should be as pale and colorless as possible, just as is also true for straight mineral spindle oils.

Another important factor is cleanliness. We must remember that spindle oils are very highly refined products, and that every care has been taken in refinement, handling and storage to keep them free from contamination. This care should be extended to the mill, and such oils should be stored in clean containers, free from dust and dirt, and handled only in clean oil cans. Too, it will be advisable at frequent intervals to clean out spindle oil reservoirs and re-fill with fresh oil. Regardless of the means taken to prevent it, a certain amount of foreign matter will gain entry, to ultimately cause

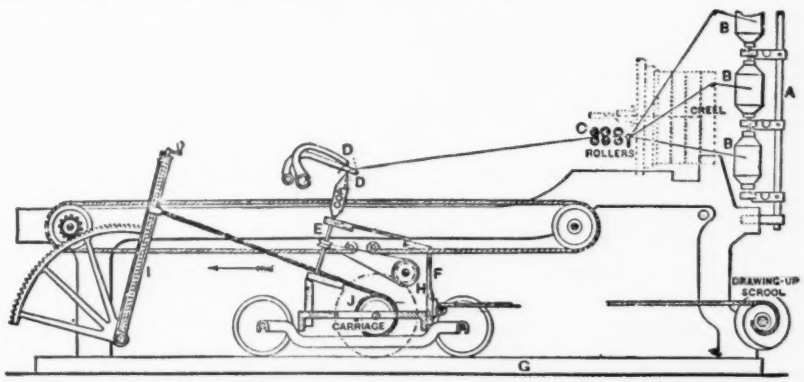


Fig. 11.—Diagram of a mule spinner showing essential working mechanisms.

wear, increased friction, discoloration of the oil and perhaps very serious staining of the yarn.

Other wearing parts of drawing, roving and spinning frames and twisters, such as gears, miscellaneous bearings, chain drives, etc., can be satisfactorily lubricated with either a 300 or 400 viscosity machine oil or medium bodied grease according to requirements or the desire

Wools for woolen manufacture are therefore far more free from grease than worsted stock. This is to be expected, however, due to the more intense scouring, and the absence of any subsequent combing process. In fact, scoured wool may be stored for an indefinite period before usage. Then, after blending, it is pickered and subjected directly to one or more

Courtesy of Saco-Lowell Shops.

Fig. 12.—A hot-air slasher. Roll bearings and gears are the essential wearing parts requiring lubrication on this machine.

to concentrate on one lubricant. For enclosed chains and gears, oil will usually be preferable and probably the more economical due to the possibility of bath lubrication.

THE MANUFACTURE OF WOOLENS

With an insight into the manufacture of worsteds, the relatively simple processes necessary to the production of woolen yarns will be readily understood. As has already been stated, the shorter staples which are practicable for woolen yarns require no straightening or paralleling of fibres. In fact, the more they are interlaced the better.

Scouring is of course the first treatment the wool receives. Due to the necessity for more complete removal of impurities and vegetable matter, it may frequently be more severe than in the scouring of wools for combing and worsted manufacture. In some cases, in fact, it will be desirable to follow up scouring with a carbonizing treatment which embodies dipping the wool in sulphuric acid or aluminum chloride, and drying at a constant temperature somewhat above 200 deg. Fahr. Vegetable matter is carbonized and removed in this way, the wool coming through clean and practically unharmed.

cardings, dependent upon the quality of the fibres.

Carding of woolen products is much similar to carding of worsteds. Usually, however, it is a more intensive operation for the primary purpose is to open up the fibres and interlace them as much as possible to enable better felting ability. The actual operation of a woolen card is practically the same as a worsted card. The removal of the product, however, differs in that the sheet of wool as lifted by the doffer is passed via a condenser to rollers or rubbing aprons which produce the small, soft slivers required for spinning on the mule frame. Carding is practically the only treatment the wool receives before spinning. Combing and drawing are unnecessary due to the fact that the more the fibres are interlocked usually the better will be the product.

Lubrication of woolen cards therefore requires but a passing remark, for it is practically the same as that of the worsted machine, which has already been discussed in detail. It might be well to mention, however, that the leather rubbing aprons through which the carded fibres pass after leaving the condenser must be protected from splashed or dripped oils. As in the case of card clothings, oil will not only cause

deterioration of the leather but will also tend to stain or discolor the wool.

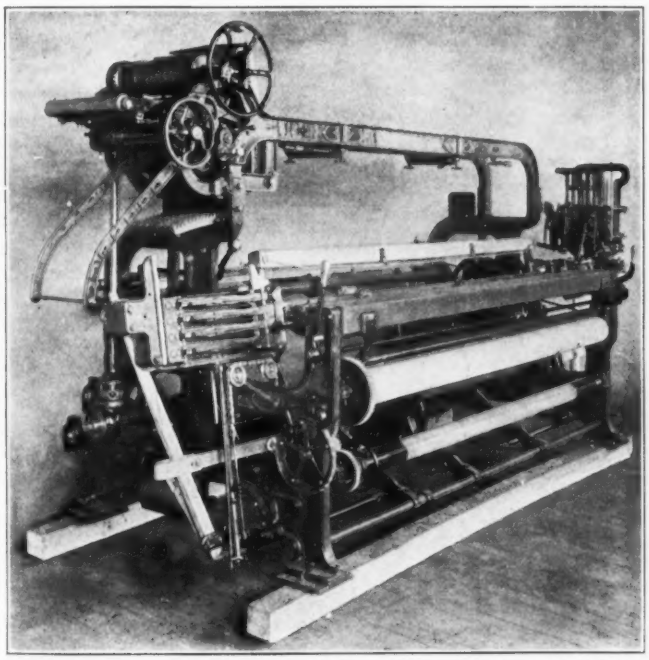
Mule Spinning

In the woolen mill the yarn will generally pass directly from the card to the spinning mule.

In the mule, which is a long and wide machine, the drawing and twisting are not continuous but consecutive. The rovings (B) (see Fig. 11 for one type of mule) are held on a creel (A) at the back of the machine, usually in three or four tiers, or on long beams or spools; they pass from the creel, between drawing rollers (C). Coming out of the rollers, they are fed to the spindles on the carriage which backs away from the creel and recedes somewhat faster than the rovings are unwound. This receding is the essential motion of the mule, for thus the material receives its final drawing. The spindles, meanwhile, are revolving rapidly, spinning the yarn. The twist goes first to the thin places where the least resistance is offered. Then, as the carriage carrying the whirling spindles continues to back away, the thicker parts of the thread, being comparatively untwisted, are pulled down to the average diameter and are twisted in turn.

At the termination of the run or stretch of the carriage, the spindles increase their speed until the twisting is completed, then the carriage starts on its return trip. This reverses the spindles, and the thread which has been wound upon them is unwound, the slack being taken up by one guide wire (D) while the other guides the thread to the winding point, and winds it up in the opposite direction on the cone-shaped cops or bobbins on the spindles. The rollers do not feed out more roving as the carriage returns. Hence, there is no slack when the round trip is completed.

Following the process of spinning the yarn is then wound onto suitable spools, etc., preparatory to weaving.



Courtesy of Crompton & Knowles Loom Works.

Fig. 13.—A woolen loom. On this machine, extreme care in the matter of lubrication is necessary in order to prevent "oil spots."

Lubrication

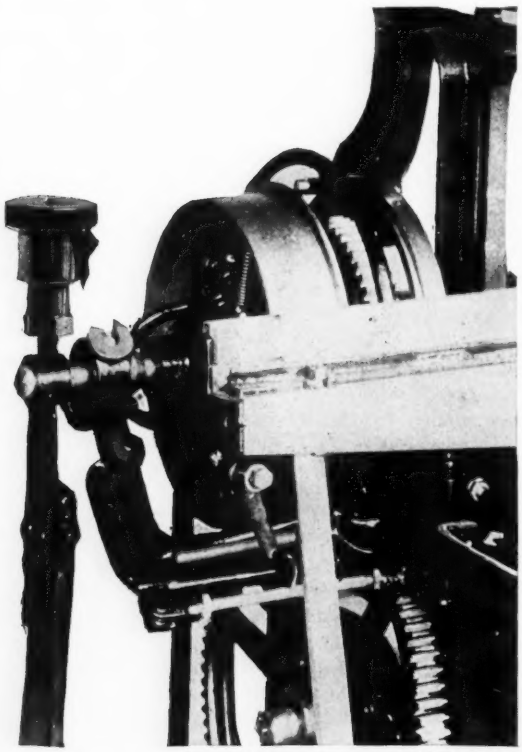
In mule spinning the lubrication requirements will, in general, differ but little from those of the ring or cap type frames. Spindle problems are essentially the same, with the exception that the bases may be open. For this reason, due to the possibility of the occurrence of oil throwing, it will frequently be advisable to use a somewhat heavier or more viscous spindle lubricant, it being, of course, necessary for the oil to remain in the base not only to insure positive lubrication but also to prevent possible staining of the yarn. As a rule an oil having a Saybolt viscosity of from 100 to 125 seconds at 100 deg. Fahr. will serve this purpose. Where mills operate both mule and other types of spinning frames, however, it will be perfectly practicable to use the same spindle oil throughout, compromising on perhaps a product of 100 seconds viscosity. This might not always give the best results, it is true, but for the sake of economic reasons, or to satisfy a desire to concentrate on one oil, it would probably meet operating conditions with average success.

For the rolls of the mule a liquid grease as recommended for ring or cap frame rolls would be suitable. Operating conditions and lubricating requirements are practically the same. Elsewhere on the mule a 300 or 400 viscosity oil or a medium bodied grease would serve the purpose, either being used judiciously according to the mode of lubrication and the function or construction of the bearings, gears or chains involved.

WEAVING OF WORSTEDS AND WOOLENS

Having spun our yarns the process of weaving is essentially the same for both worsteds

and woolens. Worsted goods are practically finished when they leave the looms; woolens, on the other hand, require a more or less extensive finishing treatment according to the nature of the cloth desired, the extent to



Courtesy of Berry Automatic Lubricators Corp.

Fig. 14.—View of a spring actuated pressure type of grease cup installed on a loom roll bearing.

which the weave is to be shown up, or the variety of finish demanded by the market.

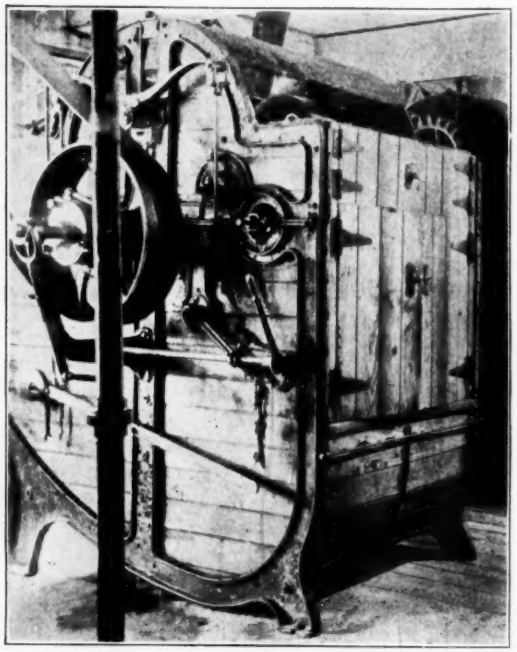
Before weaving can be accomplished, however, the yarn must be loom-mounted so to speak. This will in general involve five distinct handlings. The first is known as warping, and constitutes the arrangement of the warp or lengthwise threads in the proper order. For this purpose a warping machine can be used.

The next step is to size the warp or in other words smooth down the fibres and give the requisite strength for weaving. This is accomplished by passing the warp through a bath of starch solution, after which it is run through the compression rollers of a slasher being dried by hot air or steam. The warp is then wound onto the loom beam, which serves to deliver the threads in proper order to the loom. This beam is cylindrical in form, being mounted at the back of the loom.

From here on the preparatory processes involve the proper location of the respective threads, according to the weave or pattern desired. In the so-called healding process the warp is arranged so that the shuttle passes over certain threads and under others. The final step is known as sleying, and constitutes the leading of the warp between the reeds or wires of the sley in order to insure that each thread will keep its proper distance from the other during subsequent weaving.

The weft or crosswise threads in general will not require any additional treatment after spinning.

In the loom the yarn is finally made into cloth by interlacing the threads of the warp with those of the weft by means of a shuttle. The threads from the loom beam are threaded through eyelets in what are known as harnesses. In plain weaving there are two harnesses, and each takes every alternate thread from the beam. In fancy weaving there may be several harnesses. In operation the harnesses are raised and lowered, according to design, so that the threads give a side elevation of a V on its side. Crosswise in this V a weft thread is carried by the shuttle and pushed up close into the angle by a "reed." The harnesses then

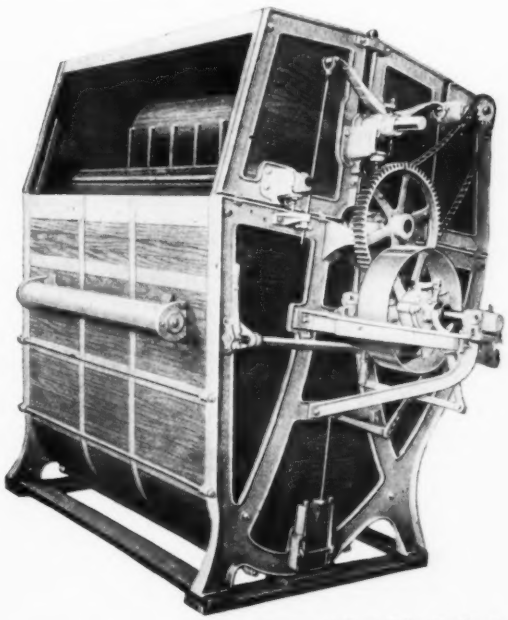


Courtesy of Hyatt Roller Bearing Co.

Fig. 15.—A fulling machine of the Rodney Hunt type equipped with roller bearings.

change position so that some or all threads that were in the upper side of the V are in the lower and vice versa, and the shuttle passes back and the reed again pushes up the thread into the angle. During the process the loom beam

feeds the threads in the proper amount and the woven cloth is wound up on a roller. Auxiliary to this operation are attachments for automatically changing bobbins, and for stopping the machine if the thread breaks or shuttle fails to cross the warp completely.



Courtesy of Hyatt Roller Bearing Co.

Fig. 16.—A James Hunter Machine Company washer, showing working mechanisms involved. It is also fitted with roller bearings.

Lubrication of Wearing Machinery

While the loom is of course the principal machine in the weaving room, the other auxiliary devices briefly mentioned above, such as the warping machine, the slasher, etc., must not be overlooked in a discussion of lubrication. The essential problem is, of course, to select and apply all lubricants in such a way as to:

(1) Prevent accidental spotting or staining of the goods as far as practicable and (2) to render the removal of such spots or stains as complete as possible in event of their occurrence.

Of course the type, frequency and manner of lubrication will depend to a great extent upon the nature and construction of the wearing elements involved. As a general rule loom parts such as the picking motions will require lubrication once or twice daily. Other bearings and gears, however, may run for longer periods without requiring re-lubrication, dependent, however, upon the clearances, the body or viscosity of the lubricant, and the means of application.

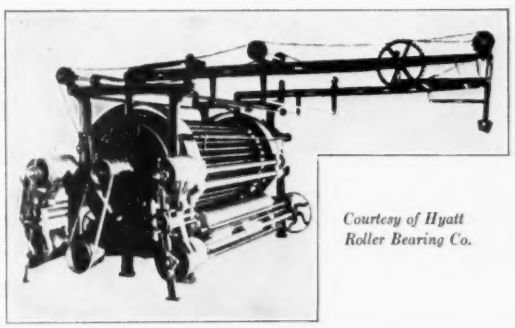
Plain bearings will predominate on the average loom and other mechanical equipment incident to weaving. Furthermore, there is but relatively little automatic lubrication in the weaving mill today, hand oiling being still the prevalent custom. In some plants the machine operators will be responsible for the lubrication of their respective looms, etc. Elsewhere it will be customary to have this taken care of by the loom fixers. This latter procedure is perhaps the most satisfactory, for there will usually be less chance of trouble occurring and in all probability greater oil economy will be attained.

For the average plain bearing provided for oil lubrication a straight mineral oil of from 300 or 400 seconds Saybolt viscosity at 100 deg. Fahr. will be suitable. Certain heavier bearings, such as those which carry the cloth rolls, etc., or the worm drives for pattern cylinders, may require a heavier product. Usually a medium liquid grease having a viscosity of from 750 to 1000 seconds Saybolt at 100° Fahr. will be satisfactory.

Gears and chains in turn will require considerable care in their lubrication to prevent dripping or throwing off the lubricant onto the woven goods. For this reason a fairly adhesive grease will generally give the best results, although it is perfectly practicable to use a relatively heavy oil if sparsely applied. Both gears and driving chains of the so-called silent type, if located in relatively oil-tight casings will probably function best if oil-lubricated with a straight mineral lubricant of approximately 100 to 150 seconds Saybolt viscosity at 210 deg. Fahr.

FINISHING MACHINERY

Worsted cloth as produced by the loom is practically a finished product, although in certain cases it may be subjected to a limited amount of fulling or shrinkage, to give it additional body, and then perhaps raised and cropped. Woolens, on the other hand, require an intensive finishing treatment which in



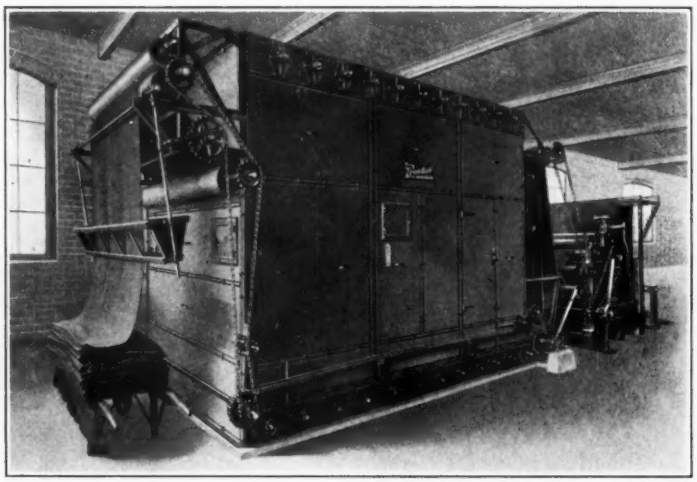
Courtesy of Hyatt Roller Bearing Co.

Fig. 17.—A napping machine of the Davis and Furber type. Here working mechanisms require careful lubrication. Roller bearings are applicable to many of the bearings.

general will materially alter the appearance of the loose, raw weave. The purpose of such treatment is of course to produce certain definite finishes according to market requirements.

As the product is received from the loom, it is inspected; then imperfections are corrected. It is then ready for the important process of fulling or shrinkage. This is carried out by running the cloth successively through soap solutions and rollers. The extent to which shrinkage will thereby occur depends, of course, upon the intensity of the fulling process. After this it may be subjected to scouring to remove the dirt.

The next step is usually raising, opening out or brushing up of the fibres into a nap, in order to enable subsequent cropping where necessary for the purpose of making the weave stand out.



Courtesy of Proctor & Schwartz, Inc.

Fig. 18.—A continuous cloth carbonizing machine showing delivery of cloth and the chain and gear mechanisms involved.

This is accomplished with the cloth either wet or dry by running it over a drum fitted with a suitable brushing device. Following this, the product is passed through a cropping or shearing machine which removes a certain amount of the nap according to the nature of the finish desired. The cloth is then ready for the final process of pressing.

Lubrication

The lubrication of finishing machinery will in general involve the same essentials as discussed under weaving, spinning, etc. The problem is distinctly a dual one of machine lubrication and cloth protection. For this reason, the same careful judgment in selecting and applying lubricants should be exercised as has been urged heretofore in this article.

In the case of scouring and fulling machinery, the possibility of soapy water, etc., penetrating to the roll bearings and perhaps washing out the lubricant must be guarded against. Lubrication can of course be best effected if the bearings are properly constructed and adequately protected. On the other hand, this is not always the case. We must remember, too, that either oil or grease can be used according to the provisions for lubrication. Grease would perhaps best meet the exacting conditions of uneven pressure and possible washing. For this purpose a product composed of a non-soluble soap will usually be most satisfactory. Its consistency should be that of a medium compression cup grease. On the other hand, where ball or roller bearings are installed, a more fluid product would be better, similar to a medium liquid grease.

Where oil lubrication is required for plain bearings, a 300 or 400 viscosity straight mineral product will probably meet conditions satisfactorily. In the case of ball and roller bearings installed in oil-tight housings, however, a viscosity of approximately 100 seconds Saybolt at 100 deg. Fahr. will be best. Here it is quite as much a problem of protecting the balls, rollers, and raceways, from corrosion as of reducing friction.

The wearing parts of other machinery such as is employed in raising, napping, cropping and pressing, etc., can usually be effectively lubricated by oils or greases of similar characteristics as above, according to the nature of their construction or the means involved for lubrication.

CONCLUSION

And so we have attempted to bring out the evident importance of lubrication in the functioning of the woolen and worsted industry. The problem throughout is an intricate one, often deceptive in its simplicity. As emphasized above, it involves protection of the wearing parts and prevention of friction, but likewise it insists on protection of the products being handled. Only can this dual object be attained by:

1. The utmost care in selecting lubricants suited to the operating conditions.
2. The use of as nearly automatic lubricating devices as possible; and
3. The exercising of intelligence and good judgment in the actual application or renewing of the lubricants.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
47 West Street, N. Y. C.